

Probability: Exercise 1  
Investigating pattern of probability for rolling two dice  
6 Peace (Suggested solution)

Stage 1

Finish the given worksheet to find out the sample space (using tables) and find theoretical probability of different events (Q1 and Q2). Then do the experiment to find out experiental outcomes and compare with your expectation.

Chance and probability – using tables

When we work out all the possible outcomes of an event that could happen, we are finding out the theoretical probability. When we do the experiment and look at the probability of what actually happened, we call it experimental probability.

Theoretical probability is:  
$$\frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$$

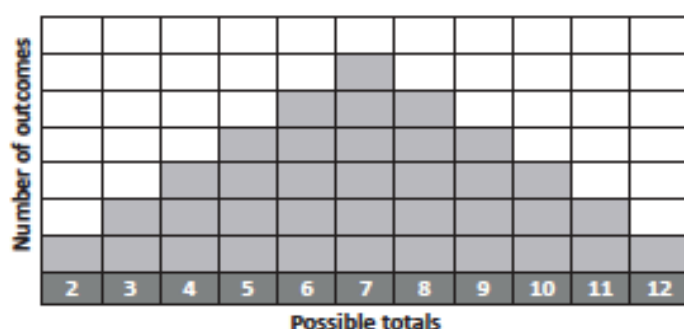
Experimental probability is:  
$$\frac{\text{number of times the event occurred}}{\text{total number of trials}}$$

- 1 When we roll 2 dice together, we can get a number of totals. Fill in this table to show the possible outcomes when 2 regular dice are rolled and added together:

		Die 1					
Die 2	+	1	2	3	4	5	6
	1	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
	6	7	8	9	10	11	12

- a How many different ways can the dice be rolled? 36
- b Which total occurred the most often? Shade this in the grid.
- c Which totals occurred the least often? Circle these on the grid.

- 2 Graph the outcomes from the table above in the grid below.  
Express the theoretical probability of the following as a fraction:



a  $7 = \frac{6}{36} = \frac{1}{6}$       b  $9 = \frac{4}{36} = \frac{1}{9}$

c  $2 = \frac{1}{36}$       d  $10 = \frac{3}{36} = \frac{1}{12}$

- 3 Now try this experiment. You will work with a partner and roll 2 dice 36 times. First make your predictions as to how often you will roll each answer. Write this in the first row. This is the theoretical probability. Now actually roll two die 36 times. In the bottom row, tally the number of times each total appears. This is the experimental probability.

Total	2	3	4	5	6	7	8	9	10	11	12
Number of times you expect to see each total	1	2	3	4	5	6	5	4	3	2	1
Number of times you actually get each total											

- 4 Look at the difference between the two rows. Is this what you expected? *Answers will vary.*

## Stage 2

Finding probability of different sum by tossing two dice.

(Suggested answer only, answer will vary for the actual number of event occurred, thus different experimental probability)

Sum of two dice	Expected number of the event occurred (in theory)	Theoretical probability $= \frac{\text{favourable outcomes}}{\text{all possible outcomes}}$	Actual number of the event occurred (from experiment of my own /group)	Experimental probability $= \frac{\text{no of times the event occurred}}{\text{total number of trial}}$	Actual number of the event occurred of the whole class (adding the result of all groups from my class)	Experimental probability
2	1	$1/36=0.028$	1	$1/36=0.028$	11	$11/396=0.028$
3	2	$2/36=0.056$	2	$2/36=0.056$	24	$24/396=0.061$
4	3	$3/36=0.083$	2	$2/36=0.056$	37	$37/396=0.093$
5	4	$4/36=0.111$	5	$5/36=0.139$	31	$31/396=0.078$
6	5	$5/36=0.139$	4	$4/36=0.111$	61	$61/396=0.154$
7	6	$6/36=0.167$	8	$8/36=0.222$	64	$64/396=0.162$
8	5	$5/36=0.139$	6	$6/36=0.167$	58	$58/396=0.146$
9	4	$4/36=0.111$	5	$5/36=0.139$	43	$43/396=0.109$
10	3	$3/36=0.083$	2	$2/36=0.056$	27	$27/396=0.068$
11	2	$2/36=0.056$	1	$1/36=0.028$	26	$26/396=0.066$
12	1	$1/36=0.028$	0	$0/36=0$	14	$14/396=0.035$
Total:	36	1	36	1	396	1

## Stage 3

Find, describe, verify and justify the pattern you have found in the theoretical probability and experimental probability at stage 1 and stage 2.

### Find and describe the pattern

I found the pattern of the theoretical probability of sum of rolling two dice from the graph of stage 1 clearly that when the sum become bigger from 2 to 7, the probability keep increasing while there are the highest chance to get a sum of "7". When the sum become bigger from 7 to 12 the probability keep decreasing, the least probability is to get the smallest sum "2" and the biggest sum "12".

### Verify the pattern

Then, I have done an experiment to verify the results and found out from the table of experimental probability that they are quite similar to the theoretical probability. Comparatively, the whole class results are more align with the theoretical probability, except for the sum of "5". Other than that the trend of probability increases from the sum as "2" to "7" then decreases from the sum as "7" to "12". The individual group results shows the same trend (except for the sum of "4" to "6").

### Justify the pattern

I can justify the pattern is correct by looking at the different combinations to get different sums and the thus finding differet theoretical probabilities.

The dice only have numbers 1, 2, 3, 4, 5, 6

Two dice's smallest sum can be  $1+1=2$  and the biggest sum is  $6+6=12$ . In both case only 1 chance out of 36 possible outcomes.

If the sum is 3, we have  $2+1$  or  $1+2$ , the same as the second biggest sum  $11=5+6$  or  $6+5$  only. Therefore the probability getting bigger towards the middle from the two ends (smallest and biggest sum).

If the sum is 4, we have  $1+3$ ,  $3+1$ ,  $2+2$  and the third biggest sum  $10 = 4+6$ ,  $6+4$  and  $5+5$ . Both have 3 chances out of 36 possible outcomes, bigger chance to get the sum of 2,3,11,12.

If the sum is 5, we have  $1+4$ ,  $4+1$ ,  $3+2$ ,  $2+3$  and the fourth biggest sum  $9 = 4+5$ ,  $5+4$ ,  $6+3$ ,  $3+6$ . Both have 4 chances out of 36 possible outcomes, bigger chance to get than the sum of 2,3,4,10,11,12.

If the sum is 6, we have  $1+5$ ,  $5+1$ ,  $4+2$ ,  $2+4$ ,  $3+3$  and the fifth biggest sum  $8 = 4+4$ ,  $5+3$ ,  $3+5$ ,  $2+6$ ,  $6+2$ . Both have 5 chances out of 36 possible outcomes, bigger chance to get than the sum of 2,3,4,5,9,10,11,12.

Lastly, to get the sum 7, we have  $1+6$ ,  $6+1$ ,  $2+5$ ,  $5+2$ ,  $3+4$ ,  $4+3$ , which is 6 chances out of 36 possible outcomes.

Therefore, the pattern of probabilities of getting different sums when tossing two dice will follow a symmetry shapes which keep increasing from the smallest sum "2" to the middle "7" then decreasing from the middle to the biggest sum "12".